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This study is the first in a series which was conducted under the name STRANGER III, and which was to examine trainee's long-term memory of motor skills. This phase examined the effects of varying fidelity of training devices on acquisition, retention, and reinstatement of ability to perform a 92-step procedural task. Three versions of the Section Control Indicator Console of the Nike-Hercules guided missile system were utilized. One version was a physical duplicate, fully powered and operational; a second had no power; and a third was a full sized color illustration of the powered version. Sixty U.S. Army trainees were randomly assigned to one of five training conditions, 12 to a group. Each subject was tested immediately after training, 4 weeks later, and 6 weeks later, and each was retrained to a criterion level. There was no difference in training time to learn the procedural task, initial performance level, amount remembered after 4 and 6 weeks, or retraining time between individuals trained on high fidelity devices and those trained on low fidelity devices. (EM)

Technical Report 69-1

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Douglas L. Grimsley

HumRRO Division No. 3 (Recruit Training)

February 1969

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Office, Chief of
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HumRRO

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE

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HumRRO Division No. 3 (Recruit Training)
Presidio of Monterey, California
The George Washington University
HUMAN RESOURCES RESEARCH OFFICE

Technical Report 69-1
Work Unit STRANGER
Sub-Unit III

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FOREWORD

The objective of HumRRO Work Unit STRANGER is to examine and obtain a better understanding of long-term memory of motor skills. STRANGER III deals with retention and retraining of skills acquired under various simulated procedures.

The research reported here is the first of a series of studies that have been conducted under STRANGER III. Subsequent reports will describe further studies on group rather than individual training, variations in low fidelity devices, and aptitude level in relation to device training. These studies are of theoretical importance for the area of simulation training and of practical significance both for economy in training and for effectiveness of training, remembering, and retraining.

The STRANGER III studies were performed during 1967 by HumRRO Division No. 3 (Recruit Training) at the Presidio of Monterey, California. Director of Research was Dr. Howard H. McFann.

Military support for the study was provided by the U.S. Army Training Center Human Research Unit. Military Chief of the Unit at the time the study was conducted was LTC David S. Marshall.

Assisting in the collection of the data were SP 4 Lynn C. Fox, SP 4 Eugene R. Brown, and SP 4 Louis E. Moore. Data analysis was performed by Mr. William H. Burckhartt.

HumRRO research for the Department of the Army is conducted under Contract DA 44-188-ARO-2 and Army Project 2J024701A712 01, Training, Motivation, Leadership Research.

Meredith P. Crawford
Director
Human Resources Research Office

SUMMARY AND CONCLUSIONS

Military Problem

There is strong evidence that simulating devices having relatively low fidelity are as effective as high fidelity devices or even the tactical equipment when training is for procedural tasks. Little is known, however, about the long-term retention and reinstatement of performance following training on low fidelity simulators. If relatively inexpensive training devices are as efficient for acquisition, retention, and reinstatement of performance as the real equipment, using them could lead to greater efficiency and training economy.

Research Problem

The purpose of STRANGER III is to examine the effects of varying fidelity of training devices on acquisition, retention, and reinstatement of ability to perform a procedural task.

Method

The subjects were trained to operate the Section Control Indicator console of the Nike-Hercules guided missile system during Blue (preparation) and Red (firing) Status. The procedure taught and the training devices used had been employed in an earlier study under HumRRO Work Unit RINGER (1). In that study men trained with a number of devices varying in functional and/or appearance fidelity were evaluated on their acquisition of ability to perform the 92-step procedural task.

In the STRANGER III experiment, subjects were trained individually on one of three panels differing in appearance and/or functional fidelity:

(1) **Hot Panel**, a physical duplicate of the tactical panel in which all lights, meters, intercom, and other indicators worked.

(2) **Cold Panel**, identical to the Hot Panel except there was no electric power.

(3) **Reproduced Panel**, a full-size artist's representation (in color) of the Hot Panel.

Sixty trainees in Advanced Individual Training from the U.S. Army Training Center at Fort Ord, California, were the subjects. They were randomly assigned to one of five training conditions, 12 to a group.

Immediately after training, each subject was tested on his ability to perform the 92-step procedural task. Each man was tested again approximately four weeks and six weeks later to see how much of the procedure he remembered; after the final test he was retrained to criterion.

Results

There were no differences in training time to learn the procedural task, initial performance level, amount remembered after four and six weeks, or retraining time between individuals trained on high, and those trained on low fidelity devices.

These results were similar to those in the research performed under Work Unit RINGER (1), in which none of the differences in average proficiency at the end of training, or average training time, were statistically significant. Men trained on low fidelity devices were as proficient as those trained with devices high in functional and appearance fidelity.

Conclusions

The fidelity of training devices used to train individuals on procedural tasks can be very low with no adverse effect on training time, level of proficiency, retention, or time to retrain.

Since substantial financial savings can be realized by using low fidelity devices, training device selection should be based on a careful review of the tasks to be taught, so that inexpensive devices can be used where possible.

CONTENTS

Acquisition, Retention, and Retraining: Effects of High and Low Fidelity in Training Devices

INTRODUCTION

There have been a number of reviews and general summaries of the literature dealing with simulator training (2-6) and its usefulness as preparation for training on the actual equipment (7, 8). Simulating devices are used extensively because the real equipment is expensive, limited in supply, and often inefficient or even dangerous for training purposes.

Devices simulating tactical equipment have been developed and tested in a number of training programs, and there is strong evidence that devices having relatively low fidelity are as effective for training certain specialties as high fidelity devices or even the tactical equipment (9-15). Most of the studies have been concerned with procedural tasks in which every action must be done in sequential order.[1]

In a series of experiments performed under HumRRO Work Unit RINGER (1), the fidelity of devices used to train men on the Nike-Hercules missile system was varied in either a functional or an appearance dimension. The results showed that the requirements for fidelity in the training device were quite low; use of the photographic reproduction trained men just as effectively as the device of highest fidelity or the actual equipment. Lowering the fidelity by reducing the size of the photographic reproduction had no effect on proficiency, as long as the elements were clearly visible.

Thus, there is evidence that even very simple devices can be used for training on procedural tasks with no loss in training time or degree of proficiency. Since demonstrations of the efficacy of training with low fidelity devices have been provided on airplanes (13), submarines (14), and tanks (17), the utility of such devices seems widely applicable.

Even though it has been shown that under certain circumstances device fidelity is relatively unimportant in training to a specified criterion, this does not answer equally important questions concerning the retention of the task performance. Is material learned under low fidelity procedures retained as long as that learned under high fidelity conditions? Is a task trained on a simulator retained equally well for high and low aptitude subjects? Is there a difference in reinstatement of performance between subjects trained on low vs. high fidelity devices? If retention is not as good, or reinstatement of performance more difficult, after training on low fidelity devices than after high fidelity device training, the latter may, in the long run, be more economical.

There are virtually no experimental results currently available that adequately answer the questions of the effect of fidelity of training devices on retention. Although some studies have been done (17, 18), results remain ambiguous.

If relatively inexpensive training devices are as efficient as the real equipment or very high fidelity devices for training and in later recall, expensive training or tactical equipment would not have to be allocated and maintained for training purposes. Savings could be substantial if the training involves expensive items

[1]As defined by R. B. Miller, a procedural task is one in which discrete, principally "all-or-none" responses are made to given cues or to specific values of cues in a continuous series of stimuli (16).

such as missiles, airplanes, and tanks. The purpose of STRANGER III is to examine the effect of varying fidelity of the training device on both acquisition and retention of a procedural task.

An initial study, utilizing the same procedural task and devices as the RINGER research but extending the experiment to retention, is reported here. Other reports are in preparation to describe further studies on the effects of group rather than individual training, of further variations in low fidelity devices, and of aptitude level in relation to device training.

APPROACH TO THE RESEARCH

Defining the Task

In a procedural task, every action or response is specified and is so simple or well known that any subject will either already know how to do it or can learn it almost immediately. What he must learn is the sequence in which the actions are to be taken, and to avoid taking any action out of turn.

The task used in this study required responses such as those made by an operator of a Section Control Indicator (SCI) panel of a Nike-Hercules guided missile system during preparation and firing status. The equipment (Figure 1) was identical to that employed in Work Unit RINGER (1). The entire sequence consists of 92 actions, which are presented in Table 1 according to the different kinds of actions and their frequency of occurrence. The complete, 92-step sequence is presented in Appendix A.

In each step, the operator receives a signal and must make a specific response to it. The signal for an action may simply be the completion of the previous action, or the action to be taken may be to monitor or wait for the next signal. Each such unit, signal and action, is considered an individual step in this procedure.

Tactical Section Control Indicator (SCI)

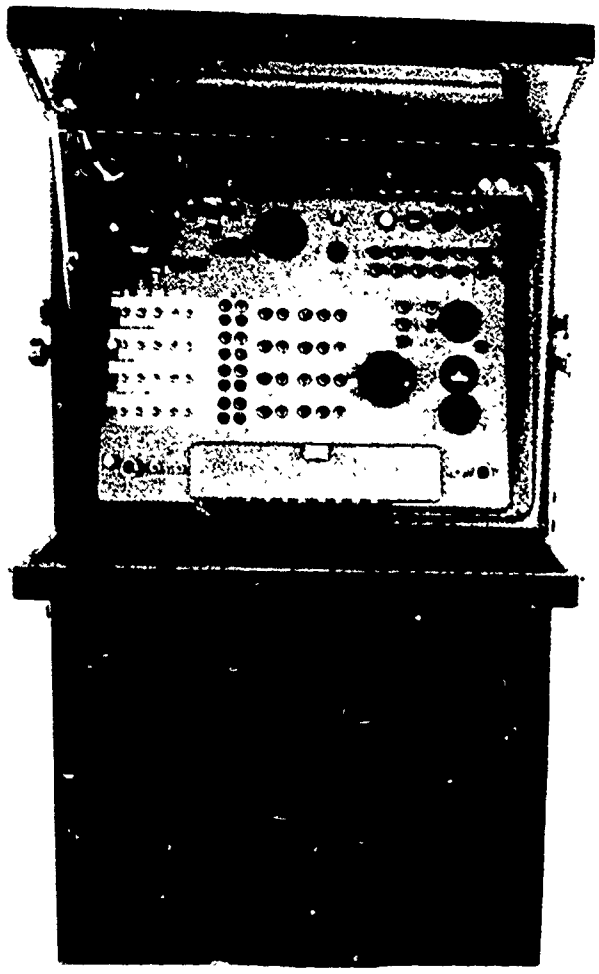

Figure 1

Subjects

Sixty trainees in Advanced Individual Training from the U.S. Army Training Center

Table 1

Description and Frequency of Required Actions in a Specified Procedural Task

Action	Frequency
Operating a toggle switch	29
Operating a push-button switch	8
Operating a rotary switch	2
Operating a rheostat control	2
Operating a banana plug	1
Writing the time	3
Giving a verbal response on phone or intercom	11
Monitoring a light	18
Monitoring a sound, oral or machine originated	16
Monitoring a meter	2

at Fort Ord, California were randomly assigned to one of five training groups, with 12 trainees in each group. No one with an Armed Forces Qualification Test (AFQT) score below 30 was included.[1]

Training Devices

Subjects were trained on one of three panels that differed in appearance or functional fidelity. These devices—three of those developed in the RINGER research—were:

(1) Hot Panel. This device is a physical duplicate of the tactical SCI. Every light, switch, meter, intercom, and telephone is functional.

(2) Cold Panel. This device is identical to the Hot Panel except that it has no electric power. Therefore, no light, meter, intercom, or telephone functions, though the switches can be operated.

(3) Reproduced Panel. This is a full-size artist's reproduction of the Hot Panel and is painted to resemble an illuminated Hot Panel.

Design

The training and test design is presented in Figure 2. Three of the trainee groups (Groups 1, 2 and 4) were always tested on the high fidelity simulator (Hot Panel), regardless of the panel on which they had been trained.

Training Groups and Panels on Which They Received Their Training and Testing

	Test Panel			
	Training Panel	Proficiency Test	Retest 1	Retest 2
Group 1	Hot	Hot	Hot	Hot
Group 2	Cold	Hot	Hot	Hot
Group 3	Cold	Cold	Hot	Hot
Group 4	Repro	Hot	Hot	Hot
Group 5	Repro	Repro	Hot	Hot

To avoid the possibility that mere exposure of all groups to the Hot Panel at the time of proficiency testing might affect retention, the two other trainee groups were not originally tested on the Hot Panel. One group (Group 3) was trained on the Cold Panel and was given the proficiency test on the Cold Panel. Similarly, one group (Group 5) was trained on the Reproduced Panel and tested initially on the Reproduced Panel. Neither of these groups was exposed to the Hot Panel until retesting, four and six weeks after training.

In addition to the acquisition and retention data, General Technical Aptitude Area (GT) and AFQT scores were obtained for each subject.

CONDUCT OF THE RESEARCH

Training Procedures

The subjects were trained individually, with two enlisted men on the research staff serving as instructors.[2] The subject was told that he would be trained to operate a piece of Nike-Hercules equipment. The instructor then showed a

[1]Low-aptitude personnel were omitted from this study and studied separately at a later date.

[2]Each instructor trained approximately the same number of subjects. All retesting was conducted by one instructor. Statistical tests indicated no significant differences between instructors on proficiency scores or on time to train for the trainees.

diagram of a typical Nike-Hercules site (see Appendix B) and described the functions of the major pieces of equipment.

Using the appropriate simulator on which the subject would be trained, a demonstration "talk-through" of the 92-step procedure was then presented. The instructor showed and described the signal for an action, and the action itself, and gave a brief, simple explanation of why the action was taken. For example, the first signal is the simultaneous onset of a Blue Status light and sound of an alarm buzzer. The proper action is to turn the power switch to the ON position. The explanation given was "turning the power switch ON provides electric power to this panel."

When the instructor had completed the 92-step demonstration, the subject attempted to perform the procedure. When an error was made, it was immediately corrected and the procedure continued. The instructor pointed out that certain sections of the procedure could be grouped for easier learning. He used verbal expressions, such as "good" and "that's right" to reinforce correct actions. (Not every action was reinforced, and no attempt was made to follow an exact schedule, although reinforcement was used more frequently in the early stages of training.)

Cueing was also used when a subject hesitated to take some specific action after he had apparently recognized the signal. For example, completion of the seventh action ("Plug the Headset-Handset into Station 2") is the signal for the eighth action, which is to announce over the Headset-Handset, "Blue Status received, Section A." If, during the training, the subject completed the seventh action and hesitated too long in making his announcement, the instructor might say, "You plugged it in, now use it." As with the verbal reinforcement, cueing was used more often in the early part of training.

A tactical SCI automatically furnishes knowledge of results to an operator after many of his actions. For example, when the prepared button for Launcher #1 is pressed, the red prepared light goes out and the green prepared light goes on. Of the simulator training devices, only the Hot Panel provided this same knowledge of results. For the other two devices, the instructor provided the trainee this information orally. Using the example above, when the prepared button was pressed, the instructor would say, while pointing to the proper lights, "Now this red light is off, and this green light is on."

On the Cold and Reproduced Panels, the subject could only "speak" certain actions instead of actually performing them. The trainee had to verbalize that "the red light is off, and the green one now is on." Trainees on the Cold Panel actually threw the switches on the panel while Reproduced Panel trainees simply went through the motions of throwing the switches.

The training session was continuous, except for an occasional brief rest break, until the subject could perform one errorless trial, or until the maximum time of three hours was reached. All subjects completed training in the time allotted.

The procedures that had been followed in the RINGER research differed in that men were trained in groups of five, rather than individually as in STRANGER. The instructor gave a demonstration "talk-through" of the procedure, then selected a trainee to attempt to perform it while the other trainees observed and helped him when he made an error. After the trainee had gone through the 92 steps, a second trainee was selected to perform and the first became an observer. Each trainee in the group performed twice and observed eight times, before being tested on the Hot Panel, whereas in STRANGER an individual's training continued until

he achieved one errorless trial (or until three hours had passed) before being tested on the Hot Panel.

Testing

Groups Initially Tested on the Hot Panel

Approximately five minutes after a subject had been trained, he was tested in order to ascertain his level of proficiency. For three of the five treatment groups, proficiency was tested on the Hot Panel, which was considered equivalent to a tactical SCI. The trainee was told that he was to perform the 92-step procedure using the Hot Panel, and that all parts of the device operated. He was cautioned to take his time and asked if he had any questions before starting. Then the instructor operated a switch that turned on the Blue Status light and the alarm buzzer, and the trainee began the test.

In every case, the alternate instructor was present in the room and acted as scorer, keeping a record of the trainee's errors. Each step omitted or taken out of sequence constituted an error. Any question the trainee asked during the procedure was answered by the instructor, and an error was scored for that step. If the trainee made an error that would have prevented continuance, the instructor corrected the error and recorded it, and the trainee continued with the test.

The trainee was told that he would be scored on accuracy only, and that time was not a factor on the test. The proficiency score was the number of steps performed correctly.

Groups Initially Tested on Cold and Reproduced Panels

Two of the treatment groups were not tested initially on the Hot Panel. Following the five-minute wait after training, the men in each group were tested on the panel on which they had been trained (one on Cold Panel, one on Reproduced Panel). The test procedure was generally the same as that followed with the Hot Panel.

Retesting and Retraining

Approximately four weeks after training (26-30 days), each subject was brought back and all were tested on the Hot Panel. The same testing procedure as previously described was used. After the test the instructor reviewed any errors made by the subject and pointed out the correct actions.

Two weeks (14-18 days) after the first retest, a second retest was given following the same test procedure. After the test, if any errors had been made they were corrected and the trainee attempted to perform the procedure correctly. Continued attempts were made until the trainee reached a criterion of 90 correct or better. Both the number of trials and time to reach criterion were recorded.

RESULTS

Data analyses are based on 12 men in each training group. Analysis of variance procedures were used to test for differences related to the use of the three training panels. Details of these analyses are presented in Appendix C. Individual scores on each variable are presented in Appendix D.

Mean scores of the five experimental groups for all of the variables studied are presented in Table 2. In conducting the analyses of variance, the two groups

initially tested on the Hot Panel and the two groups initially tested on the Cold and Reproduced Panels were compared separately with the group trained and tested on the high fidelity simulator.

Table 2

Mean Scores on Independent Variables for Experimental Groups[a]

Test	Treatment Group[b]				
	Hot/Hot	Cold/Hot	Cold/Cold	Repro/Hot	Repro/Repro
AFQT Score[c]					
Mean	78.1	78.8	58.4	79.2	70.5
SD	22.3	20.2	20.0	10.3	23.2
GT Score[c]					
Mean	122.0	124.0	106.0	126.0	116.0
SD	17.7	16.9	21.7	11.9	17.9
Time to Train (minutes)					
Mean	114.0	113.3	118.3	97.3	132.3
SD	21.9	30.1	30.0	30.5	37.2
Proficiency Score					
Mean	90.9	89.2	90.1	88.3	89.5
SD	1.0	3.1	1.6	3.4	3.6
Retest 1 Score					
Mean	75.7	75.0	75.4	75.1	71.7
SD	5.2	4.3	6.1	8.0	8.3
Retest 2 Score					
Mean	82.9	83.3	83.3	83.6	83.3
SD	4.6	4.8	6.5	5.0	5.5
Trials to Retrain					
Mean	2.5	2.5	2.3	2.2	2.5
SD	1.0	0.8	0.4	0.7	1.0
Time to Retrain (minutes)					
Mean	20.7	19.9	19.0	17.8	21.1
SD	10.3	6.9	4.0	8.3	10.4

[a]Designation indicates method by which the subject was trained and method by which his proficiency was originally tested.
[b]Analyses of variance for these groups showed that differences were not significant.
[c]Mean scores somewhat above the average Army input for all groups.

None of the comparisons indicated significant differences (see Appendix C). In training time, initial performance level, amount remembered after four and six weeks, or retraining time, results were similar for individuals trained on high and low fidelity simulators.

DISCUSSION

Acquisition

The results of the study indicate that men can be trained to perform a procedural task as well on very simple, low fidelity devices as on a functional, high fidelity device. These results are consistent with those of other researchers

who have shown that for fixed procedural tasks, fidelity is relatively unimportant in the training device (1, 9-16). Moreover, the actual proficiency scores obtained are similar to those reported under Work Unit RINGER (1) using the same equipment, even though the training procedures were somewhat different.

Retention

Regardless of the fidelity of the training device, all subjects retained the material equally well for more than a month. Of greatest interest was the finding that the groups remembered equally well even when they had not been exposed to the high fidelity device during training. Swanson (18) found, similarly, that differences associated with the use of various types of training aids were negligible immediately after training and also approximately six to eight weeks after training.

Reinstatement

When retraining to restore the original level of performance, men in the groups trained on the low fidelity devices relearned just as fast as men in the groups trained on the high fidelity device. This was true even though two of the groups had not been exposed to the high fidelity device until the time of retraining.

It seems clear from this study that high fidelity simulation is not a mandatory requirement for procedural tasks. Without exception, training on a simplified device resulted in high positive transfer to the criterion task, and, most important, retention of the skill was comparable for all groups.

Knowledge that simple devices are sufficient for training with no sacrifice of retention of performance can mean that it is feasible to use training devices that are less complex, less expensive, and easier to maintain than high fidelity devices. Low fidelity devices may serve as trainers for trainers, or to introduce procedures of practice in basic skills, or to prepare trainees for practice on complicated simulators or the tactical equipment. For instance, low fidelity devices have been shown to be as good as the real equipment for training the following tasks: learning basic instrument and radio-range procedures in aircraft (12); control of course and depth of a submarine (14); pre-start check, engine start, engine run-up, and engine shut-down of aircraft (13); preparation and firing status of a Nike-Hercules guided missile system (1), and starting and stopping procedures in a tank (11).

They may be used to advantage where practice on a task is impossible, for example, for reserve units.

CONCLUSIONS

The fidelity of training devices used to train men in procedural tasks can be very low with no adverse effect on training time, level of proficiency, amount remembered over time, or time to retrain. Trainees who do not even see the operational device can still perform efficiently with a high degree of transfer. High fidelity devices simply are not necessary to train on these types of tasks.

Since the financial saving realized in using low fidelity devices could be great,[1] selection of training devices should be based on a careful review of the tasks to be taught to determine where inexpensive devices could be used.

[1]For example, the estimated cost of the high fidelity simulator (Hot Panel) developed in the RINGER research was $3,000 while the Reproduced Panel cost approximately $100.

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AND
APPENDICES

LITERATURE CITED

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Appendix A

COMPLETE SEQUENCE OF PROCEDURAL TASK

Standard Blue Status Procedures

Operator is standing before the SCI, which is open but "cold." He is monitoring for Blue Status light and Alarm buzzer to sound.

SIGNAL	ACTION
1. Buzzer and Blue Status light.	1. Throw Power switch to ON. 2. Throw Panel Light switch to ON. 3. Put hand under Panel Light to check for illumination level. 4. Adjust light level with control knob. 5. Throw all four Intercom (IC) switches to ON. 6. Throw all four Launcher Power switches to ON. 7. Plug Handset-Headset (HH) set into Station 2. 8. Announce "Blue Status received, Section A" on HH set. 9. Put IC switch to TALK and hold. 10. Announce "Blue Status" on IC. 11. Check and adjust mike level while announcing. 12. Release IC switch to LISTEN. 13. Press Alarm shutoff button till buzzer stops. 14. Monitor for "All crewmen present" on IC.
2. "All crewmen present" on IC.	15. Announce "All crewmen present, Section A" on HH set. 16. Monitor for "Battle Stations" on HH set.
3. "Battle Stations" on HH set.	17. Announce "Battle Stations received, Section A" on HH set. 18. Operate IC switch. 19. Monitor for green ON DECK light. 20. Announce "Battle Stations" on IC.
4. Green ON DECK light.	21. Monitor for "Launcher prepared" on IC.
5. "Launcher #1 prepared" on IC.	22. Press PREPARED button for #1.

SIGNAL	ACTION
	23. Monitor for green #1 PREPARED and SAME light.
6. Green #1 PREPARED and SAME light on.	24. Monitor for "Launcher prepared" on IC.
7. "Launcher #2 prepared" on IC.	25. Press PREPARED button for #2.
	26. Monitor for green #2 PREPARED and SAME light.
8. Green #2 PREPARED and SAME light on.	27. Monitor for "Launcher prepared" on IC.
9. "Launcher #3 prepared" on IC.	28. Press PREPARED button for #3.
	29. Monitor for green #3 PREPARED and SAME light.
10. Green #3 PREPARED and SAME light.	30. Monitor for "Launcher prepared" on IC.
11. "Launcher #4 prepared" on IC.	31. Press PREPARED button for #4.
	32. Monitor for green #4 PREPARED and SAME light.
12. Green #4 PREPARED and SAME light on.	
	33. Monitor for "Launcher ready" on IC.
13. "Launcher #1 ready" on IC.	34. Operate IC switch.
	35. Announce "Stand clear, Launcher #1 going up" on IC.
	36. Throw Launcher Elevation (LE) switch for #1 to UP.
14. Noise on IC.	37. Monitor noise on IC till it stops.
	38. Throw LE switch for #1 to OFF.
	39. Monitor for "Launcher ready" on IC.
15. "Launcher #2 ready" on IC.	40. Operate IC switch.
	41. Announce "Stand clear, Launcher #2 going up" on IC.
	42. Throw LE switch for #2 to UP.
16. Noise on IC.	43. Monitor noise on IC till it stops.
	44. Throw LE switch for #2 to OFF.
	45. Monitor for "Launcher ready" on IC.
17. "Launcher #3 ready" on IC.	46. Operate IC switch.
	47. Announce "Stand clear, Launcher #3 going up" on IC.
	48. Throw LE switch for #3 to UP.
18. Noise on IC.	49. Monitor noise on IC till it stops.
	50. Throw LE switch for #3 to OFF.
	51. Monitor for "Launcher ready" on IC.

SIGNAL	ACTION
19. "Launcher #4 ready" on IC.	52. Operate IC switch. 53. Announce "Stand clear, Launcher #4 going up" on IC. 54. Throw LE switch for #4 to UP.
20. Noise on IC.	55. Monitor noise on IC till it stops. 56. Throw LE switch for #4 to OFF. 57. Wait for Section Chief.
21. Section Chief comes into revetment. 22. Section Chief turns safety keys to FIRE. 23. All four LAUNCHER READY lights on.	58. Throw all four IC switches to OFF. 59. Monitor for four amber LAUNCHER READY lights. 60. Throw Heaters and Gyros (H&G) switch for #1 to ON. 61. Record time on log. 62. Monitor for green READY TO FIRE light for #1.
24. Green READY TO FIRE light #1 on.	63. Throw DESIGNATE switch to #1 strip. 64. Press LAUNCHER DESIGNATE button. 65. Monitor for green LAUNCHER DESIGNATE light.
25. Green LAUNCHER DESIGNATE light on. 26. Smooth movement of needle full left to full right twice.	66. Press SLEW button and hold through check. 67. Throw SECTION READY switch to READY. 68. Monitor for green SECTION READY light.
27. SECTION READY green light on. 28. Section Chief says "Blue Status checks complete."	69. Wait for Section Chief to OK. 70. Announce "Blue Status checks complete, Section A" on HH set.

Standard Red Status Procedures

Operator is standing in front of open SCI. Power is on. Blue Status is on. Checks are complete. Operator is wearing Handset-Headset (HH) set and is monitoring for Red Status.

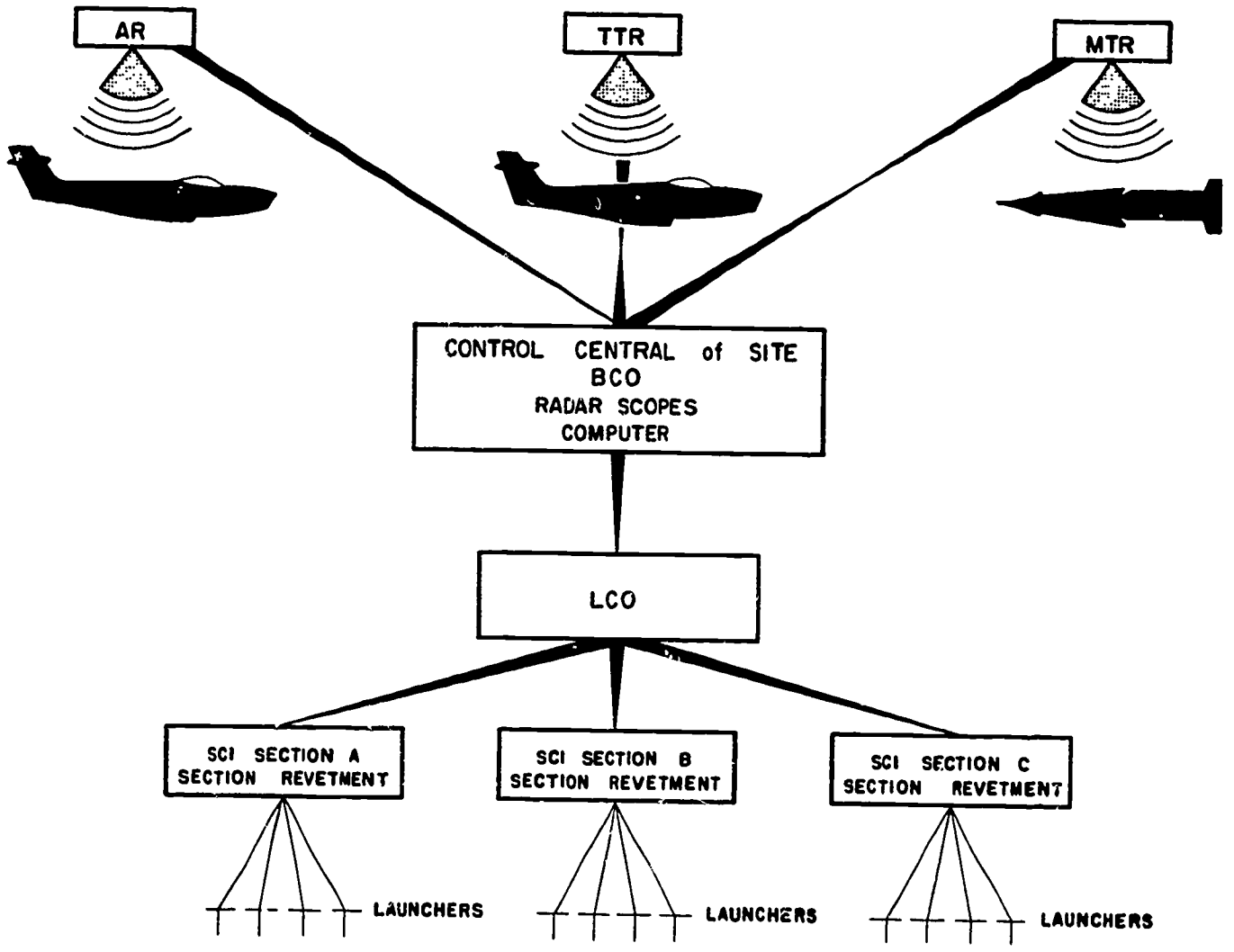
SIGNAL	ACTION
1. Red Status light on.	1. Monitor for Red Status light. 2. Announce over HH set, "Red Status received, Section A." 3. Monitor for green SELECTED light.
2. Green SELECTED light on.	4. Throw Heaters and Gyros (H&G) switch for #2 to ON. 5. Record time on log.

SIGNAL	ACTION
	6. Monitor for buzzer and green FIRE, LAUNCH ORDER, and MISSILE AWAY lights.
3. Buzzer, green FIRE, LAUNCH ORDER, and MISSILE AWAY lights on.	7. Throw SECTION READY switch down (OFF).
	8. Throw LAUNCHER ELEVATION switch for #1 to DOWN.
	9. Monitor for green READY TO FIRE light on #2.
	10. Move LAUNCHER ELEVATION switch for #1 to OFF.
4. Green #2 READY TO FIRE light on.	11. Throw DESIGNATE switch to #2 strip.
	12. Press LAUNCHER DESIGNATE button.
	13. Monitor for green LAUNCHER DESIGNATE light.
5. Green LAUNCHER DESIGNATE light on.	14. Press SLEW button.
	15. Monitor SLEW METER for correct check.
6. Smooth movement of needle left to 0, right to 0, twice.	16. Throw SECTION READY switch up (ON).
	17. Monitor for green SECTION READY light.
7. Green SECTION READY light on.	18. Monitor for green SELECTED light.
8. Green SELECTED light on.	19. Throw H&G switch for #3 to ON.
	20. Record time on log.
	21. Monitor for Buzzer and green FIRE, LAUNCH ORDER, and MISSILE AWAY lights.
9. Buzzer and green FIRE, LAUNCH ORDER, and MISSILE AWAY lights on.	22. Throw SECTION READY switch down (OFF).

Appendix B

ORIENTATION TO THE NIKE HERCULES SITE AND THE SECTION CONTROL INDICATOR (SCI)

The Nike Hercules is primarily an antiaircraft missile and can be armed with a nuclear warhead. The site consists of approximately eight major pieces of equipment. The layout varies from site to site, depending on geographic conditions, and on this chart you see one example of a basic site layout. This could represent an area of several miles, and the only consistency is the separation of the IFC (Integrated Fire Control) area (the upper half of the diagram) from the launching area.



Acquisition Radar (AR)

The AR operates continually as it searches the area of protection. When a target has been acquired, the AR sends azimuth and range data to the Target Tracking Radar through the computer.

Target Tracking Radar (TTR)

The TTR locks on the target and tracks it until the target is either released by the Battery Control Officer (BCO) or destroyed by the selected missile. The tracking data is fed to the computer to enable it to plot the missile course to the intercept point.

Missile Tracking Radar (MTR)

When the missile is fired the MTR controls the flight pattern and sends missile position data to the computer.

The three radars have operators constantly monitoring the display scopes.

Battery Control Officer (BCO)

The computer information is monitored by the BCO who makes the final decision whether a missile should be launched.

Launcher Control Officer (LCO)

The LCO relays the commands from the BCO to the Section Control Indicator (SCI) operators. The LCO controls 12 missiles through three SCI panels, and it is his responsibility to select a missile for firing.

Section Control Indicator (SCI)

The operator of the SCI coordinates his duties with his Section Chief and the LCO. He checks the SCI daily and maintains communication between the LCO and the launcher crew. The SCI supplies the power to the four missiles on the launchers. The SCI operator is responsible for the crewmen and the status of the missile during this procedure.

You are here to learn the SCI procedures in Blue Status and Red Status. Blue Status is the procedure taken to prepare a missile for firing, and Red Status is the actual firing procedure.

Do you have any questions?

Appendix C

ANALYSIS OF VARIANCE TABLES

Table C-1

AFQT Scores

Source	*df*	*MS*	*F*
Between	4	953.56	2.44
Within	55	390.38	
Total	59		

Table C-2

GT Scores

Source	*df*	*MS*	*F*
Between	4	732.81	2.39
Within	55	306.73	
Total	59		

Table C-3

Proficiency Score

Source	*df*	*MS*	*F*
Between	4	11.31	1.48
Within	55	7.62	
Total	59		

Table C-4

Time to Train

Source	*df*	*MS*	*F*
Between	4	1839.28	2.00
Within	55	920.03	
Total	59		

Table C-5

Retest 1

Source	*df*	*MS*	*F*
Between	4	32.39	<1
Within	55	43.29	
Total	59		

Table C-6

Retest 2

Source	*df*	*MS*	*F*
Between	4	0.67	<1
Within	55	28.34	
Total	59		

Table C-7

Trials to Retrain

Source	*df*	*MS*	*F*
Between	4	0.32	<1
Within	55	0.67	
Total	59		

Table C-8

Time to Retrain

Source	*df*	*MS*	*F*
Between	4	17.14	<1
Within	55	71.78	
Total	59		

Appendix D

INDIVIDUAL SCORES ON EACH INDEPENDENT VARIABLE

Table D-1

Individual Scores on Hot-Hot

Subject	AFQT	GT	Time to Train (min.)	Number Correct	Retest #1	Retest #2	Trials to Retrain	Time to Retrain (min.)
1	65	111	150	92	75	80	5	39
2	94	130	126	92	72	73	2	16
3	89	128	126	92	80	86	2	17
4	65	129	132	91	67	75	4	44
5	94	149	72	91	83	85	2	20
6	87	126	108	91	67	87	3	25
7	95	136	120	91	80	85	2	16
8	89	124	114	91	75	84	2	16
9	39	85	108	91	79	84	2	14
10	33	93	126	91	76	84	2	14
11	93	121	108	89	73	85	2	14
12	94	127	78	89	81	87	2	13
Mean	78.1	121.6	114.0	90.9	75.7	82.9	2.5	20.7
SD	22.3	17.7	21.9	1.0	5.2	4.6	1.0	10.3

Table D-2

Individual Scores on Cold-Hot

Subject	AFQT	GT	Time to Train (min.)	Number Correct	Retest #1	Retest #2	Trials to Retrain	Time to Retrain (min.)
1	98	144	90	92	76	85	2	14
2	56	112	180	92	75	83	2	17
3	87	129	168	91	77	86	4	26
4	99	141	90	91	81	88	2	13
5	89	121	73	91	75	82	3	24
6	67	109	150	90	67	75	3	31
7	95	136	100	90	76	85	3	24
8	95	124	90	90	80	92	1	7
9	81	136	132	88	72	77	3	25
10	80	117	148	88	80	84	2	14
11	32	83	120	86	70	78	3	24
12	67	130	90	81	71	84	2	20
Mean	78.8	123.5	113.3	89.2	75.0	83.3	2.5	19.9
SD	20.2	16.9	30.1	3.1	4.3	4.8	.8	6.9

Table D-3

Individual Scores on Cold-Cold

Subject	AFQT	GT	Time to Train (min.)	Number Correct	Retest #1	Retest #2	Trials to Retrain	Time to Retrain (min.)
1	56	79	120	92	65	69	3	20
2	33	94	138	91	88	88	2	15
3	63	111	84	91	77	89	2	16
4	91	128	90	91	82	89	2	15
5	63	120	90	91	68	80	3	25
6	33	94	132	91	76	76	2	17
7	37	102	126	91	73	89	2	17
8	46	119	95	90	72	82	2	15
9	79	141	120	90	74	91	2	16
10	59	83	155	88	80	84	2	18
11	89	128	90	88	75	79	2	17
12	52	74	180	87	75	83	3	27
Mean	58.4	106.1	118.3	90.1	75.4	83.3	2.3	18.2
SD	20.0	21.7	30.0	1.6	6.1	6.5	.4	4.0

Table D-4

Individual Scores on Repro-Hot

Subject	AFQT	GT	Time to Train (min.)	Number Correct	Retest #1	Retest #2	Trials to Retrain	Time to Retrain (min.)
1	71	120	108	92	75	82	3	23
2	77	130	72	91	88	92	1	6
3	72	130	84	91	86	91	1	7
4	88	120	100	91	74	81	3	21
5	81	132	96	91	85	87	2	15
6	88	141	65	90	72	84	3	28
7	87	135	70	89	68	83	3	36
8	59	112	90	89	78	86	2	16
9	98	126	114	86	72	83	2	15
10	82	141	110	85	61	74	2	16
11	72	100	84	83	69	78	2	19
12	76	121	180	82	73	82	2	16
Mean	79.3	125.7	97.8	88.3	75.1	83.6	2.2	18.2
SD	10.3	11.9	30.5	3.4	8.0	5.0	.7	8.3

Table D-5

Individual Scores on Repro-Repro

Subject	AFQT	GT	Time to Train (min.)	Number Correct	Retest #1	Retest #2	Trials to Retrain	Time to Retrain (min.)
1	61	117	84	92	76	82	2	13
2	31	102	150	92	63	80	3	27
3	86	122	114	92	78	82	3	24
4	50	97	84	92	83	87	2	17
5	99	130	168	91	71	82	2	17
6	81	143	66	91	73	90	1	8
7	71	107	180	91	68	78	4	33
8	98	140	132	90	82	90	1	7
9	63	106	162	89	68	89	3	24
10	37	83	160	89	62	80	3	25
11	98	128	138	85	79	87	2	15
12	71	122	150	80	57	72	4	43
Mean	70.5	116.4	132.3	89.5	71.7	83.3	2.5	21.1
SD	23.2	17.9	37.2	3.6	8.3	5.5	1.0	10.4

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13. ABSTRACT

To examine the effects of varying fidelity of training devices on acquisition, retention, and reinstatement of a procedural task, soldiers were trained individually to operate the Section Control Indicator (SCI) console of the Nike Hercules guided missile system during preparation and firing status. Subjects with no previous experience on the equipment were trained on one of three panels differing in appearance, functional fidelity, or both, and tested immediately after training. Approximately four and six weeks later they were retested and retrained to the original level of proficiency. Results indicated that there was no difference in training time, initial performance level, amount remembered after four and six weeks, or retraining time, between individuals trained on high and low fidelity devices for procedural tasks.

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Training						
Training Devices						

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1 CG US ARMY AD COMD ENT AFB ATTN ADGCB
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1 CG 3RD US ARMY FT MCPHERSON GA
1 CG FOURTH ARMY FT SAM HOUSTON ATTN G3
3 CG FIFTH ARMY FT SHERIDAN ATTN ALFGC TNG
1 CG SIXTH ARMY PRES OF SAN FRAN ATTN AHAAV
1 CG EUSA ATTN AG-AC APO 96301 SAN FRAN
2 CG EUSA ATTN G-3 APO 96301 SAN FRAN
1 DIR HEL APG MD
1 CG USA CDC EXPERIMENTATION COMD FT ORD
2 ENGNR PSYCHOL LAB PIONEERING RES DIV ARMY NATICK LABS NATICK MASS
1 TECH LIB ARMY NATICK LABS NATICK MASS
3 CO DEF DEVEL ENGNR LAB EDGEWOOD ARSENAL
1 CO USA CDC INST OF LAND CBT FT BELVOIR
1 CO USA CDC CBR AGCY ALA
1 REDSTONE SCIENTIFIC INFO CTR US ARMYMSL COMD ATTN CHF DOC SEC ALA
1 CO USAPA MBLTY DET TOBYHANNA ARMY DEPOT
1 CG ARMY ELEC PG FT HUACHUCA ATTN TECH LIB
12 CO 1ST AIR DEF GUIDED MSL BRGD TNG FT BLISS
2 CG US ARMY CDC EXPERIMENTATION COMD FT ORD
1 SIXTH U S ARMY LIB DEPOT BLDG N 13 14 PRES OF SAN
1 PLANS OFFICER PSYCH HDQTRES USACDCECFORT ORD
9 CG FT ORD ATTN G3 TNG DIV
1 DIR WALTER REED ARMY INST OF RES WALTER REED ARMY MED CTR
2 DIR WALTER REED ARMY INST OF RES WALTER REED ARMY MED CTR
ATTN NEUROPSYCHIAT DIV
1 CO HQ ARMY ENLISTED EVAL CTR FT BENJ HARRISON
1 DPTY FOR BIOASTRONAUT PG AIR PG CTR EGLIN AFB
1 CO USA MOBILITY EQUIP R&D CTR ATTN TECH DOC CTR FT. BELVOIR
1 CO FRANKFORD ARSNL ATTN SMUFA-N6400/202-4
1 CG 20 RGN ARADCOM RICHARDS-GEBAUR AFB
1 CG 9TH RGN USARADCOM ATTN G3 TNG GUNTER AFB ALA
3 6TH RGN USARADCOM FT BAKER
1 4TH ARMY MSL COMD AIR TRANSPORTABLE SAN FRAN
1 PERS SUBSYS DIV CREW SUBSYS DRCT AERONAUT SYS DIV WRIGHT-PATT.,SON AFB
1 DIR ARMY BD FOR AVN ACCIDENT RES FT RUCKER
2 CO PICATINNY ARSNL DOVER N J ATTN SUMPA VCI
1 DEF SUPPLY AGY CAMERON STATION ATTN LIB
1 CO ARMY CBT DEVEL COMD FT BENJ HARRISON ATTN ADJ GEN AGY
1 REP M MS IS NASA ALA
1 CBT OPNS RES GP CDC FT BELVOIR ATTN SR OPRS ANLS HUMAN FACTORS
1 CO ARMY CDC INF AGY FT BENNING
1 CO ARMY CDC ARMOR AGY FT KNOX
6 ARMY CDC SPEC WARFARE AGY FT BRAGG
1 EVAL DIV DAD ARMY SIG CTR & SCH FT MONMOUTH
1 CO US ARMY CDC AVN AGCY FT RUCKER
1 CHF CURRICULUM BR RESIDENT INSTR DEPT ARMY LOGISTICS MANGT CTR FT LEE
3 CO ARMY CBT DEVEL COMD CBT SUPPORT GP
9 CIVLN PERS OFCR US ARMY SPT CTR ST LOUIS ATTN EMPLOYEE DEVEL OFCR
3 LIB ARMY WAR COLL CARLISLE BKS
1 COMDT ARMY INTEL SCH ATTN AHBQ-AD FT HOLABIRD
1 COMDT COMD & GEN STAFF CO FT LEAVENWORTH ATTN ARCHIVES
1 DIR OF MILIT PSYCHOL & LDRSHP US MILIT ACAD WEST POINT
1 US MILIT ACAD WEST POINT ATTN LIB
1 COMDT ARMY AVN SCH FT RUCKER ATTN SCH LIB
2 COMDT ARMY SECUR AGY TNG CTR & SCH FT DEVENS ATTN LIB
1 MED FLD SERV SCH BROOKE ARMY MED CTR FT SAM HOUSTON ATTN STIMSON LIB
10 DIR OF INSTR ARMOR SCH FT KNOX
1 COMDT ARMY ARMOR SCH FT KNOX ATTN WEAPONS DEPT
1 COMDT ARMY CHAPLAIN SCH FT HAMILTON
1 COMDT ARMY CHEM CORPS SCH FT MCCLELLAN ATTN EDUC ADV
1 ARMY FINANCE SCH FT BENJ HARRISON
4 COMDT ARMY ADJ GEN SCH FT BENJ HARRISON ATTN EDUC ADV
1 EDUC ADV USAIS ATTN AJIIS-H FT BENNING
1 DIR OF INSTR USAIS ATTN AJIIS-O-EPRO FT BENNING
1 HQ US ARMY ADJ GEN SCH FT BENJ HARRISON ATT COMDT
1 LIB ARMY QM SCH FT LEE
1 COMDT ARMY QM SCH FT LEE ATTN EDUC ADV
1 COMDT ARMY TRANS SCH FT EUSTIS ATTN EDUC ADV
1 CO USA SEC AGY TNG CTR & SCH ATTN IATEV RSCH ADV FT DEVENS
1 COMDT ARMY MILIT POLICE SCH FT GORDON ATTN DIR OF INSTR
2 COMDT US ARMY SOUTHEASTERN SIG SCH ATTN: EDUC ADVISOR FT GORDON
1 COMDT USA AD SCH FT BLISS
1 CG ARMY ORD CTR & SCH ABERDEEN PG ATTN AISD-SL
9 ASST COMDT ARMY AIR DEF SCH FT BLISS ATTN CLASSF TECH LIB
9 CG ARMY ARTY & MSL CTR FT SILL ATTN AVN OFFR
1 COMDT ARMY DEF INTEL SCH ATTN SI&AS DEPT
1 COMDT ARMED FORCES STAFF COLL NORFOLK
1 COMDT ARMY SIG SCH FT MONMOUTH ATTN EDUC COORD
1 COMDT JUDGE ADVOCATE GENERALS SCH U OF VA
1 DPTY COMDT USA AVN SCH ELEMENT GA
1 DPTY ASST COMDT USA AVN SCH ELEMENT GA
1 USA AVN SCH ELEMENT OFC OF DIR OF INSTR ATTN EDUC ADV GA
1 EDUC CONSLT ARMY MILIT POLICE SCH FT GORDON
6 COMDT ARMY ENGNR SCH FT BELVOIR ATTN AIBBES-SY
2 COMDT US ARMY SCH EUROPE ATTN REF LIB APO 09172 NY
1 CHF POLICY & TNG LIT DIV ARMY ARMOR SCH FT KNOX
1 COMDT ARMY AVN SCH FT RUCKER ATTN EDUC ADV
1 COMDT ARMY PRIMY HEL SCH FT WOLTERS
1 DIR US MIL ACAD WEST POINT
1 DIR OF MILIT INSTR US MILIT ACAD WEST POINT
1 SPEC WARFARE SCH LIB FT BRAGG
4 USA SPEC WARFARE SCH ATT: COUNTERINSURGENCY DEPT FT BRAGG
1 ARMY SIG CTR & SCH FT MONMOUTH ATTN TNG LIT DIV DAD
2 SECY US ARMY MSL & MUNITIONS CTR & SCH REDSTONE ARSNL
2 COMDT WOMENS ARMY CORPS SCH & CTR FT MCCLELLAN

2 HQ ABERDEEN PG ATTN TECH LIB
1 COMDT US ARMY INTEL SCH FT HOLABIRD
1 COMDT ARMY QM SCH DFC DIR OF NONRESID ACTVY FT LEE ATTN TNG MEDIA DIV
2 DIR BRGD & BN OPNS DEPT USAIS FT BENNING
1 DIR COMM ELEC USAIS FT BENNING
1 DIR ABN-AIR MOBILITY DEPT USAIS FT BENNING
1 DIR COMPANY TACTICS DEPT USAIS FT BENNING
1 CG US ARMY SIGNAL CTR & SCH ATTN SIGOTL-3 (COURT II)
1 SECY OF ARMY, PENTAGON
1 OCS-PERS DA ATTN CHF C&S DIV
1 DIR OF PERS STUDIES & RES DOCSPER DA ATTN BG WALLACE L CLEMENT
1 CO FOREIGN SCI & TECH CTR RUN BLDG
2 AGS FOR FORCE DEVEL DA ATTN CHF TNG DIV
1 CG USA MAT COMD ATTN AMCRD-TE
1 CHF OF ENGNRS DA ATTN ENGTE-T
1 HQ ARMY MAT COMD R&D DRCTE ATTN AMCRD-RC
1 CHF OF PERS OPNS OFCR PERS DRCTE DA ATTN SIG BR
2 CG ARMY MED R&D COMD ATTN BEHAV SCI RES BR
1 US ARMY BEHAVIORAL SCI RES LAB WASH, D.C. ATTN: CRD-AR
1 DPD PERS MGT DEV OFC ATTN MOS SEC (NEW EQUIP) OPOMO
1 ARMY PROVOST MARSHAL GEN
1 DIR CIVIL AFFAIRS DRCTE DOCSOPS
1 OFC RESERVE COMPON DA
2 CHF ARMY SECUR AGY ARLINGTON HALL STA ATTN AC OF S G1
90 ADMIN DOC ATTN: TCA (HEALY) CAMERON STA ALEX., VA. 22314
1 CO US ARMY MED RES LAB FT KNOX
1 CG ARMY ELECT COMD FT MONMOUTH ATTN AMSEL CB
1 CHF OF R&D DA ATTN CHF TECH & INDSTR LIAISON OFC
1 CO USA ELCT COMD ATTN AMSEL-ROD
2 CG ARMY MED R&D COMD ATTN MEDDH-SR
1 U S ARMY BEHAVIORAL SCI RES LAB WASH, D.C. ATTN CRD-AIC
1 COMDT ARMY CBT SURVEIL SCH FT HUACHUCA ATTN ATSUR SB
2 TNG & DEVEL DIV DOCS-PERS
1 CO US ARMY MAT COMD WASH D.C. ATTN: AMCPT-CM ROBT DETIENNE
2 PRES ARMY ARMOR BD FT KNOX
1 PRES ARMY INF BD FT BENNING ATTN FE&SP DIV
2 PRES ARMY AIR DEF BD FT BLISS ATTN MST DIV
1 PRES ARMY MAINT BD FT KNOX
2 PRES ARMY AVN TEST BD FT RUCKER
2 PRES ARMY ARTY BD FT SILL
1 LIB ARMY ABN ELEC & SPEC WARFARE BD FT BRAGG
1 DPTY PRES ARMY MAT COMD BD ABERDEEN PG
1 CO ARMY CBT DEVEL COMD MILIT POLICE AGY FT GORDON
1 US ARMY ARCTIC TEST CTR R & D OFFICE SEATTLE
1 CG 2D ARMORED DIV FT HOOD ATTN DIV AVN OFCR
10 CG 4TH ARMORED DIV APO 09326 NY
2 CO 16TH ARMOR GP FT. KNOX
5 CO 2D ARMORED CAV REGT APO 09696 NY
1 CO 3D ARMORED CAV REGT APO 09034 NY
4 CO 14TH ARMORED CAV REGT APO 09026 NY
2 CG ARMY ARMOR & ARTY FIRING CTR FT STEWART ATTN AC OF S TNG OPCR
1 1ST ARMORED DIV HQ & HQ CO FT HOOD ATTN AC OF S G2
10 1ST INF DIV 1ST MED TANK BN 63D ARMOR FT RILEY
8 3D INF DIV 1ST BN 64TH ARMOR APO 09036 NY
2 1ST TANK BN 73D ARMOR 7TH INF DIV APO 96207 SAN FRAN
8 8TH INF DIV 2D BN 68TH ARMOR APO 09034 NY
1 CO COMPANY A 3D BN 32D ARMOR 3D ARMORED DIV (SPEARHEAD) APO 09039 NY
1 CO 1ST BN 69TH ARMOR APO 96278 SAN FRAN
1 CO 9TH BN 33D ARMOR FT KNOX
1 CO 3D MED TANK BN 68TH ARMOR ATTN S3APO 09028 NY
1 CO 3D MED TANK BN 37TH ARMOR APO 09066 NY
5 CO 2D BN 34TH ARMOR APO 96266 SAN FRAN
2 CALIF NG 40TH ARMORED DIV LOS ANGELES ATTN AC OF S G3
1 55TH COMD HQ DIV ARMY NG JACKSONVILLE FLA
4 CO 150TH AVN BN NJ AIR NG ELIZABETH
1 CG HQ 27TH ARMORED DIV NY AIR NG SYRACUSE
1 TEXAS NG 49TH ARMORED DIV DALLAS
1 CG ARMY ARMOR CTR FT KNOX ATTN G3 AIBKGT
2 CG 1ST INF DIV ATTN G3 APO 96345 SAN FRAN
1 CG 3RD INF DIV ATTN G3 NY
3 CG 4TH INF DIV ATTN G3 APO 96262 SAN FRAN
1 CG 7TH INF DIV ATTN G2 APO 96207 SAN FRAN
1 CG 8TH INF DIV ATTN G2 APO 09111 NY
1 CG 9TH INF DIV (MECH) FT CARSON
5 CG 24TH INF DIV ATTN G3 FT RILEY
3 CG 82D ABN INF DIV FT BRAGG ATTN G3
1 CO 197TH INF BRGD FT BENNING ATTN S3
1 CO 1ST BN (REINF) 3D INF (THE OLD GUARD) FT MYER
7 CO 3D BN 6TH INF REGT APO 09742 NY
1 CO 171ST INF BRGD APO 98731 SEATTLE
3 CG 25TH INF DIV APO 96225 SAN FRAN
1 CO 3D BN 39TH INF APO 09029 NY
1 CO 1ST BN 39TH INF APO 09034 NY
1 CO 2ND BN 15TH INF NY ATTN S 3
4 CO 1ST BN (MECH) 92D INF 1ST ARMORED DIV (OLD IRONSIDES) FT HOOD
2 4TH BN (MECH) 54TH INF FT KNOX
1 CO ARMY PARTIC GP NAV TNG DEVICE CTR PT WASHINGTON ATTN CODE 01A
2 CONSOL RES GP 7TH PSYOP GP APO 96248 SAN FRAN
2 DA OFC OF ASST CHF OF STAFF FOR COMM-ELCT ATTN CETS-6 WASH
1 CG MILIT DIST OF WASHINGTON
1 US DOCU OFCR OFC OF US NATL MILIT REP SHAPE APO 09055 NY
1 SYS RES GP ENGNR EXPRN STA COLUMBUS ?
1 DIR ARMY LIB PENTAGON
1 STRATEGIC PLANNING GP CORPS OF ENGNR ARMY MAP SERV
1 CHF OF MILIT HIST DA ATTN GEN REF BR
1 CO 24TH ARTY GP (AD) COVENTRY
1 CG 31ST ARTY BRGD AIR DEF OAKDALE PENNA
1 49TH ARTY GP AIR DEF FT LAWTON
2 HQ 4/59TH ARTY REGT NORFOLK
1 28TH ARTY GP AIR DEF SELFRIDGE AFB
1 92D ARTY BRGD AD FT HANCOCK
1 HQ NIAGARA-BUFFALO DEF 31ST ARTY BRGD AIR DEF LOCKPORT
1 HQ 49TH ARTY BRGD AIR DEF ARLINGTON HTS ILL
1 39TH ARTY BRGD AIR DEF FT GED G MEADE
1 CG 101ST ABN DIV FT CAMPBELL
1 CG 1ST CAV DIV APO 96490 SAN FRAN
1 US ARMY GEN EQUIP ATTN TECH LIB FT LEE
1 US ARMY TROPIC TEST CTR PO DRAWER 942 ATTN BEHAV SCIENTIST FT CLAYTON
2 CINC US PACIFIC FLT FPO 96614 SAN FRAN
1 CINC US ATLANTIC FLT CODE 512A NORFOLK ATTN LTC DOTY

1 CINC PACIFIC OPNS ANLS SECT FPO 96610 SAN FRAN
1 COR TNG COMMAND US PACIFIC FLT SAN DIEGO
1 CHF BUR OF MED + SURG ON ATTN CODE 513
5 TECH LIB PERS 110 BUR OF NAV PERS ARL ANNEX
3 DIR PERS RES DIV BUR OF NAV PERS
1 TECH LIB BUR OF SHIPS CODE 210L NAVY DEPT
2 NAV AIR SYS COMD REP ATLANTIC NAV AIR STA NORFOLK
1 HUMAN FACTORS BR PSYCHOL RES DIV ONR
1 ENGNR PSYCHOL BR ONR CODE 455 ATTN ASST HEAD WASH DC
3 CO + DIR NAV TNG DEVICE CTR ORLANDO ATTN TECH LIB
1 CO PLT ANTI-AIR WARFARE TNG SAN DIEGO
1 CO NUCLEAR WEAPONS TNG CTA PACIFIC U S NAV AIR STA SAN DIEGO
1 CO NAV AIR DEVEL CTR JOHNSVILLE PENNA ATTN NADC LIB
2 PLT ANTI-AIR WARFARE TNG CTR DAM NECK VA BEACH
2 CO PLT TNG CTR NAV BASE NEWPORT
1 COR PLT TNG CP NAV BASE CHARLESTON
2 CO PLT TNG CTR NORFOLK
1 CO FLEET TNG CTR U S NAV STA SAN DIEGO
1 CLIN PSYCHOL MENTAL HYGIENE UNIT US NAV ACAD ANNAPOLIS
1 PRES NAV WAR COLL NEWPORT ATTN MAHAN LIB
1 CO NAV GUIDED MSL SCH DAM NECK VA BEACH
2 CO + DIR ATLANTIC FLT ANTI-SUB WARFARE TACTICAL SCH NORFOLK
1 CO NUCLEAR WEAPONS TNG CTR ATLANTIC NAV AIR STA NORFOLK
2 CO PLT SONAR SCH KEY WEST
1 CO PLT ANTI-SUB WARFARE SCH SAN DIEGO
1 CHF OF NAV RES ATTN SPEC ASST FOR R & D
1 CHF OF NAV RES ATTN HEAD PERS + TNG BR CODE 458
1 CHF OF NAV RES ATTN HEAD GP PSYCHOL BR CODE 452
1 DIR US NAV RES LAB ATTN CODE 5120
5 CO OFF OF NAV RES BR OFFICE BOX 39 FPO 09510 NY
1 CHF OF NAV AIR TNG TNG RES DEPT NAV AIR STA PENSACOLA
1 CO NAV SCH OF AVN MED NAV AVN MED CTR PENSACOLA
1 CO MED FLD RES LAB CAMP LEJEUNE
1 COR NAV MSL CTR POINT MUGU CALIF ATTN TECH LIB CODE 3022
1 DIR AEROSPACE CREW EQUIP LAB NAV AIR ENGNR CTR PA
1 CO + DIR NAV ELEC LAB SAN DIEGO ATTN LIB
3 OIC NAV PERS RES ACTVY SAN DIEGO
1 NAV NEUROPSYCHIAT RES UNIT SAN DIEGO
2 COR NAV MSL CTR CODE 5342 POINT MUGU CALIF
1 DIR PERS RES LAB NAV PERS PROGRAM SUPPORT ACTIVITY WASH NAV YD
1 NAV TNG PERS CTR NAV STA NAV YD ANNEX CODE 83 ATTN LIB WASH
1 COMDT MARINE CORPS HQ MARINE CORPS ATTN CODE AO-1B
1 HQ MARINE CORPS ATTN AX
1 DIR MARINE CORPS EDUC CTR MARINE CORPS SCH QUANTICO
1 DIR MARINE CORPS INST ATTN EVAL UNIT
1 CHF OF NAV OPNS OP-01P1
1 CHF OF NAV OPNS OP-03T
1 CHF OF NAV OPNS OP-07T2
2 COMDT HQS 8TH NAV DIST ATTN EDUC ADV NEW ORLEANS
1 CHF OF NAV AIR TECH TNG NAV AIR STA MEMPHIS
1 DIR OPS EVAL GRP OFF OF CHF OF NAV OPS OP03EG
2 COMDT PTP COAST GUARD HQ
1 CHF OPCR PERS RES + REVIEW BR COAST GUARD HQ
1 OPNS ANLS OFC HQ STRATEGIC AIR COMD OFFUTT AFB
1 CINC STRATEGIC AIR COMD OFFUTT AFB ATTN SUP-3
1 AIR TNG COMD RANDOLPH AFB ATTN ATFTM
1 HQ AIR TNG COMD ATTBS RANDOLPH AFB
1 CHF SCI DIV DRCTE SCI + TECH DCS R+D HQ AIR FORCE AFRSTA
1 CHF OF PERS RES BR DRCTE OF CIVILIAN PERS DCS-PERS HQ AIR FORCE
1 CHF ANAL DIV (AFPDPL (R) DIR OF PERSONNEL PLANNING HQS USAF
1 FAA CHF INFO RETRIEVAL BR WASH D.C.
1 FED AVN AGY MED LIB HQ-640
1 HQ AFSC SCBB ANDREWS AFB
1 ROME AIR DEVEL CTR RASH GRIFFISS AFB
2 COR ELEC TYS DIV L G HANSCOM FLD BEDFORD MASS ATTN ESRHA
2 SACRAMENTO AIR MAT AREA SMACU-PERS RES MCCLELLAN AFB
1 ATC ATXRQ RANDOLPH AFB
1 HQ SAMSO (SMSIR) AF UNIT POST OFC LA AFS CALIF
2 MILIT TNG CTR OPE LACKLAND AFB
2 6570TH AERO MED RES LAB NRPT WRIGHT-PATTERSON AFB
1 AIR MOVEMENT DESIGNATOR AMRH BROOKS AFB
1 HQS ATC DCS/TECH TNG (ATTMS) RANDOLPH AFB
4 HQ AIR TRANS COMD ATCTD-M RANDOLPH AFB
1 COR ELEC SYS DIV LG HANSCOM FLD ATTN ESTI
1 DIR AIR U LIB MAXWELL AFB ATTN AUL3T-63-253
1 AIR FORCE SCH OF AEROSPACE MED BROOKS AFB ATTN AEROMED LIB
1 DIR OF LIB US AIR FORCE ACAO
1 COMDT DEF WPNS SYS MGT CTR AF INST OF TECH WRIGHT-PATTERSON AFB
1 COMDT ATTN LIB DEF WPNS SYS MGT CTR AF INST OF TECH WRIGHT-PATTERSON AFB
1 DRCTE OF AEROSPACE SAFETY AFIAS-L OPTY IG NORTON AFB
1 6570TH PERS RES LAB FRA-4 AEROSPACE MED DIV LACKLAND AFB
1 TECH TNG CTR (LMTC/OP-I-L1) LOWRY AFB
2 AF HUMAN RESOURCES LAB HRHTO WRIGHT-PATTERSON AFB
2 CO HUMAN RESOURCES LAB BROOKS AFB
1 PSYCHOBIOLOGY PROG NATL SCI FOUND
1 DIR NATL SECUR AGY FT GEO G MEADE ATTN TOL
1 DIR NATL SECUR AGY FT GEO G MEADE ATTN DIR OF TNG
5 CIA ATTN OCR/ADD STANDARD DIST
1 SYS EVAL DIV RES DIRECTORATE DDD-DCD PENTAGON
1 DEPT OF STATE BUR OF INTEL + RES EXTERNAL RES STAFF
1 SCI INFO EXCH WASHINGTON
2 CHF MGT & GEN TNG DIV TR 200 FAA WASH DC
1 BUR OF RES & ENGR US POST OFC DEPT ATTN CHF HUMAN FACTORS BR
1 EDUC MEDIA BR OE DEPT OF HEW ATTN T D CLEMENS
1 OFC OF INTERNATL TNG PLANNING & EVAL BR AID WASH DC
1 SYS DEVEL CORP SANTA MONICA ATTN LIB
2 DUNLAP + ASSOC INC DARIEN ATTN LIB
2 RESEARCH ANALYSIS CORP MCLEAN VA 22101
1 RAND CORP WASHINGTON ATTN LIB
1 DIR RAND CORP SANTA MONICA ATTN LIB
2 U OF SO CALIF ELEC PERS RES GP
1 COLUMBIA U ELEC RES LABS ATTN TECH EDITOR
1 MITRE CORP BEDFORD MASS ATTN LIB
2 U OF PGH LEARNING R+D CTR ATTN DIR
1 HUMAN SCI RES INC NORFOLK
1 HUMAN SCI RES INC MCLEAN VA
2 TECH INFO CTR ENGNR DATA SERV N AMER AVN INC COLUMBUS O
1 CHRYSLER CORP MSL DIV DETROIT ATTN TECH INFO CTR

1 AVCO CORP AVCO MSL SYS DIV ATTN RSCH LIB WILMINGTON MASS
1 RAYTHEON CO ELEC SERV OPNS BURLINGTON MASS
2 EDUC & TNG CONSULTANTS ATTN L C SILVERN LA
1 GEN DYNAMICS POMONA DIV ATTN LIB DIV CALIF
1 AVN SAFETY ENGR S RES DIV OF FLIGHT SAFETY FOUND INC PHOENIX
2 MARQUARDT CORP POMONA CALIF ATTN DEPT 580
2 OTIS ELEVATOR CO DIV ATTN LIB STAMFORD CONN
1 CHF PERS SUBSYS AIRPLANE DIV MS 74-90 RENTON WASH
1 THIOKOL CHEM CORP HUMETRICS DIV LOS ANGELES ATTN LIBN
2 CTR FOR RES IN SOCIAL SYS PLO OFC FT BRAGG
1 INST FOR DEF ANLS RES + ENGNR SUPPORT DIV WASHINGTON
1 HUGHES AIRCRAFT COMPANY CULVER CITY CALIF
1 DIR CTR FOR RES ON LEARNING + TEACHING U OF MICH
1 EDITOR TNG RES ABSTR AMER SOC OF TNG DIRS U OF TENN
1 HUMAN FACTORS SECT R+D GEN DYNAMICS ELECTRIC BOAT GROTON
1 CTR FOR RES IN SOCIAL SYS AMER U
5 BRITISH EMBSY BRITISH DEF RES STAFF WASHINGTON
3 CANADIAN JOINT STAFF OFC OF DEF RES MEMBER WASHINGTON
3 CANADIAN ARMY STAFF WASHINGTON ATTN GSO2 TNG
2 CANADIAN LIAISON OFCR ARMY ARMOR BD FT KNOX
1 GERMAN LIAISON OFCR ARMY AVN TEST BD FT RUCKER
3 ACS FOR INTEL FOREIGN LIAISON OFCR TO NORWEG MILIT ATTACHE
2 ARMY ATTACHE ROYAL SWEDISH EMBSY WASHINGTON
1 NATL INST FOR ALCOHOL RES OSLO
1 DEF RES MED LAB ONTARIO
2 FRENCH LIAISON OFCR ARMY AVN TEST BD FT RUCKER
1 BRITISH LIAISON OFCR ARMY AVN TEST BD FT RUCKER
1 OFC OF AIR ATTACHE AUSTRALIAN EMBSY ATTN: T.A. NAVGN WASH, D.C.
1 YORK U DEPT OF PSYCHOL
2 AUSTRALIAN EMBSY OFC OF MILIT ATTACHE WASHINGTON
2 U OF SHEFFIELD DEPT OF PSYCHOL
1 MENNINGER FOUND, ION TOPEKA
2 AMER INST FOR RES SILVER SPRING
1 AMER INST FOR RES PGH ATTN LIBN
1 DIR PRIMATE LAB UNIV OF WIS MADISON
3 MATRIX CORP ALEXANDRIA ATTN TECH LIBN
1 AMER TEL+TEL CO NY
1 U OF GEORGIA DEPT OF PSYCHOL
1 OBERLIN COLL DEPT OF PSYCHOL
1 DR GEORGE T HAUTY CHMN DEPT OF PSYOLU OF DEL
1 GEN ELECTRIC CO SANTA BARBARA ATTN LIB
1 VITRO LABS SILVER SPRING MD ATTN LIBN
1 HEAD DEPT OF PSYCHOL UNIV OF SC COLUMBIA
1 TENN VALLEY AUTHORITY ATTN CHF LABOR RELATIONS BR DIV OF PERSONNEL KNOXVILLE
1 U OF GEORGIA DEPT OF PSYCHOL
1 GE CO WASH D C
1 AMER INST FOR RES PALO ALTO CALIF
1 MICH STATE U COLL OF SOC SCI
1 N MEX STATE U
1 ROWLAND + CO HADDONFIELD NJ ATTN PRES
1 NORTRONICS DIV OF NORTHROP CORP ANAHEIM CALIF
1 OHIO STATE U SCH OF AVN
2 AIRCRAFT ARMAMENTS INC COCKEYSVILLE MD
2 OREGON STATE U DEPT OF MILIT SCI ATTN ADJ
1 TUFTS U HUMAN ENGNR INFO + ANLS PROJ
1 HUMAN FACTORS RES GP WASH U ST LOUIS
1 AMER PSYCHOL ASSOC WASHINGTON ATTN PSYCHOL ABSTR
1 ND ILL U HEAD DEPT OF PSYCHOL
1 GEORGIA INST OF TECH DIR SCH OF PSYCHOL
1 BELL TEL LABS INC TECH INFO LIB WHIPPANY LAB NJ ATTN TECH REPORTS LIBN
1 ENGNR LIB FAIRCHILD HILLER REPUBLIC AVN DIV FARMINGDALE N Y
1 WASHINGTON ENGNR SERV CO INC KENSINGTON MD
1 LIFE SCI INC FT WORTH ATTN PRES
1 AMER BEHAV SCI CALIF
2 DIR INSTR RESOURCES STATE COLL ST CLOUD MINN
1 COLL OF WM + MARY SCH OF EDUC
1 SO ILLINOIS U DEPT OF PSYCHOL
2 COMMUNICABLE DISEASE CTR DEVEL + CONSULTATION SERV SECT ATLANTA
2 WASH MILITARY SYS DIV BETHESDA MD
1 NORTHWESTERN U DEPT OF INDSTR ENGNR
1 HONEYWELL ORD STA MAIL STA 806 MINN
1 NY STATE EDUC DEPT ABSTRACT EDITOR AVCR
1 AEROSPACE SAFETY DIV U OF SOUTHERN CALIF LA
1 MR BRANDON B SMITH RES ASSOC U OF MINN
1 CTR FOR THE ADVANCED STUDY OF EDUC ADMIN ATTN IONE PIERRON U OF OREG
1 A A HEVL ASSOC DIR CAREL WASH DC
1 CHF PROCESSING DIV DUKE U LIB
1 U OF CALIF GEN LIB DOCU DEPT
1 FLORIDA STATE U LIB GIFTS + EXCH
1 HARVARD U PSYCHOL LABS LIB
1 U OF ILL LIB SER DEPT
2 U OF KANSAS LIB PERIODICAL DEPT
1 U OF NEBRASKA LIBS ACQ DEPT
1 OHIO STATE U LIBS GIFT + EXCH DIV
1 PENNA STATE U PATTEE LIB DOCU DESK
1 PURDUE U LIBS PERIODICALS CHECKING FILES
1 STANFORD U LIBS DOCU LIB
1 LIBN U OF TEXAS
1 SYRACUSE U LIB SER DIV
1 U OF MINNESOTA LIB
1 STATE U OF IOWA LIBS SER ACQ
1 NO CAROLINA STATE COLL DH HILL LIB
2 BOSTON U LIBS ACQ DIV
1 U OF MICH LIBS SER DIV
1 BROWN U LIB
2 COLUMBIA U LIBS DOCU ACQ
1 DIR JOINT U LIBS NASHVILLE
1 U OF DENVER MARY REED LIB
2 DIR U LIB GEO WASHINGTON U
2 LIB OF CONGRESS CHF OF EXCH + GIFT DIV
1 U OF PGH DOCU LIBN
1 CATHOLIC U LIB EDUC & PSYCHOL LIB WASH DC
1 U OF KY MARGARET I KING LIB
1 SO ILL U ATTN LIBN SER DEPT
1 KANSAS STATE U FARRELL LIB
1 BRIGHAM YOUNG U LIB SER SECT
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